CLAIMS

1. A method of measuring stress using laser photoelasticity,

A method of measuring stress using laser photoelasticity, wherein an infrared laser beam from a laser source is impinged upon a polarizer in which the laser beam is converted into a linear polarized light wave that oscillates in a fixed direction on a plane perpendicular to the light path axis; the linear polarized light wave is impinged upon a photoelastic modulator, such that the optical axis matches the light path axis, in which a linear polarized light wave is converted into a modulation polarized wave that changes continuously from linearly polarized light to circularly polarized light with a predetermined frequency; the modulation polarized wave is passed through a first quarter-wave plate and a second quarter-wave plate in this order and impinged upon an analyzer in which the modulation polarized wave is converted into a linear modulation polarized wave that oscillates in another direction; the linear modulation polarized wave is impinged upon a photodetector in which an electric signal corresponding to the physical property of the linear modulation polarized wave is generated;

then, a test sample is disposed between the first quarter-wave plate and the second quarter-wave plate; the modulation polarized wave is passed there through; and the electric signal generated at the photodetector when the test sample is not disposed between the first quarter-wave plate and the second quarter-wave plate is compared with the transmission electric signal when the test sample is disposed between the first quarter-wave plate and the second quarter-wave plate and the stress of the test sample is determined,

wherein the method comprising:

input of the electric signal in a DC-voltage indicator to cause the indicator to indicate the detected value;

rotating the polarizer about the light path axis such that the transmission principal axis S perpendicular to the light path is positioned orthogonally to the oscillation direction F of the linear modulation polarized wave and the minimum value that the DC-voltage indicator indicates becomes M;

then, rotating the polarizer +45 degrees such that the DC-voltage indicator indicates a predetermined increased value M0 (M0>M);

rotating the analyzer such that the principal axis S2 thereof is positioned orthogonally to the principal

axis S of the polarizer whereby the linear modulation polarized wave arriving at the photodetector decreases and the minimum value that the DC-voltage indicator indicates becomes Mm1;

then, rotating the polarizer such that the principal axis S thereof is positioned orthogonally to the principal axis S2 of the analyzer whereby the minimum value that the DC-voltage indicator indicates further decreases to Mm2;

repeating these operations such that the value that the DC-voltage indicator indicates gradually decreases to Mmn (Mm1>Mm2>...>Mmn);

rotating the photoelastic modulator such that the principal axis W thereof matches the principal axis S of the polarizer whereby the minimum value that the DC-voltage indicator indicates becomes Mx;

rotating the first quarter-wave plate such that the principal axis H thereof matches the principal axis S of the polarizer whereby the minimum value that the DC-voltage indicator indicates decreases to Mxm;

then, rotating the first quarter-wave plate +45 degrees such that the value that the DC-voltage indicator indicates becomes a predetermined increased value Mx1 (Mx1>Mxm);

rotating the second quarter-wave plate such that the

principal axis J thereof is positioned orthogonally to the principal axis H of the first quarter-wave plate whereby the minimum value that the DC-voltage indicator indicates deceases to Mx1m (Mx1>Mx1m);

finally rotating the polarizer +45 degrees such that the principal axis S thereof and the principal axis S2 of the analyzer forms an angle whereby the value that the DC-voltage indicator indicates increases to x1m (x1m>Mx1m) which is a reference electric signal;

supplying the reference electric signal to the DC-voltage indicator and an amplifier, wherein the amplifier amplifies the reference electric signal and supplies the amplified signal to a signal processor, and the signal processor generates reference signal data;

then, disposing a test sample between the first quarter-wave plate and the second quarter-wave plate, passing the modulation polarized wave there through, at this time the photodetector generates a transmission electric signal and supplies the transmission electric signal to the DC-voltage indicator and the amplifier, wherein the amplifier amplifies the transmission electric signal and supplies the amplified signal to the signal processor, and the signal processor generates transmission signal data; and

then, comparing the reference signal data with the

transmission signal data and determining the stress of the test sample.

2. A device for measuring stress using laser photoelasticity, comprising:

a laser light source which produces infrared laser light;

a polarizer, disposed on a light path of the laser light, upon which the laser light is incident and which outputs a linearly polarized wave that oscillates in a fixed direction;

a photoelastic modulator upon which the linearly polarized wave is incident and which outputs a modulation polarized wave that continuously changes from linearly polarized light to circularly polarized light at a predetermined frequency;

a first quarter-wave plate and a second quarter-wave plate upon which the modulation polarized wave are incident in this order;

an analyzer upon which the modulation polarized wave is then incident and which outputs a linear modulation polarized wave which oscillate in another direction;

a photodetector upon which the linear modulation polarized wave is incident and which outputs an electric signal corresponding to a physical property thereof; and

a signal processor which compares an electric signal generated at the photodetector when a test sample is not disposed between the first quarter-wave plate and the second quarter-wave plate with a transmission electric signal when a test sample is disposed between the first quarter-wave plate and the second quarter-wave plate and the modulation polarized wave is passed there through, and determines the stress of the test sample,

wherein the device for measuring stress further comprises a DC voltage indicator which receives the electric signal that the photodetector generates and indicates a detected numeric value in a DC-voltage indicator to cause the indicator to indicate the detected value, and an amplifier which receives and amplifies the reference electric signal that the photodetector generates;

the polarizer is rotated and positioned such that the transmission principal axis thereof is positioned orthogonally to the oscillation direction of the laser light whereby the minimum value that the DC voltage indicator indicates becomes M, and then the polarizer is rotated +45 degrees such that the value that the DC-voltage indicator indicates becomes a predetermined increased value M0 (M0>M);

the analyzer is rotated such that the principal axis

thereof is positioned orthogonally to the principal axis of the polarizer whereby the linear modulation polarized wave arriving at the photodetector decreases and the minimum value that the DC-voltage indicator indicates becomes Mm1;

then, the polarizer is rotated such that the principal axis S thereof is positioned orthogonally to the principal axis of the analyzer whereby the minimum value that the DC-voltage indicator indicates further decreases to Mm2; these operations are repeated whereby the angular position of the polarizer and the analyzer is set such that the value that the DC-voltage indicator indicates gradually decreases to Mmn (Mm1>Mm2>...>Mmn);

the photoelastic modulator is rotated such that the principal axis W thereof matches the principal axis S of the polarizer whereby the angular position is set such that the minimum value that the DC-voltage indicator indicates becomes Mx;

the first quarter-wave plate is rotated such that the principal axis H thereof matches the principal axis S of the polarizer whereby the angular position is set such that the minimum value that the DC-voltage indicator indicates decreases to Mxm;

the first quarter-wave plate is rotated +45 degrees whereby the angular position is set such that the value

that the DC-voltage indicator indicates becomes a predetermined increased value Mx1 (Mx1>Mxm) and the first quarter-wave plate has a property to convert the modulation polarized light from the photoelastic modulator to swirling linearly-polarized light;

in order that swirling of the linearly polarized light imparted by the first quarter-wave plate is countered when the second quarter-wave plate receives the linearly polarized light, the second quarter-wave plate is rotated whereby the angular position is set such that the principal axis thereof is positioned orthogonally to the principal axis direction of the first quarter-wave plate and the minimum value that the DC voltage indicator indicates decreases to Mx1m (Mx1>Mx1m);

the polarizer is further rotated +45 degrees such that the principal axis thereof and the principal axis of the analyzer forms an angle, and the value that the DC-voltage indicator indicates is set as a reference electric signal of an increased value x1m (x1m>Mx1m);

the signal processor receives the reference electric signal amplified by the amplifier and generates reference signal data; and

then, a test sample is disposed between the first quarter-wave plate and the second quarter-wave plate, the modulation polarized wave is passed there through, at

this time, the photodetector generates a transmission electric signal and supplies the transmission electric signal to the amplifier, the amplifier amplifies the transmission electric signal and supplies the amplified signal to the signal processor, and the signal processor generates transmission signal data, and the signal processor compares the reference signal data with the transmission signal data and determines the stress of the test sample.

3. The stress measurement device according to claim 2, wherein the photodetector further comprising a thermostatic element having a cooling part and a heat radiation part which operate when power is applied thereto, wherein the photodetector is integrally placed adjacent to the cooling part.

4. A method of measuring stress using laser photoelasticity,

wherein an infrared laser beam from a laser source is impinged upon a polarizer positioned on an optical path, the polarizer converts the laser beam into a linearly-polarized light wave that oscillates in a fixed direction and outputs the linearly-polarized light wave, the linearly-polarized light wave is impinged upon a

photoelastic modulator, the photoelastic modulator converts the linearly polarized light wave into a modulation polarized wave that changes continuously from linearly polarized light to circularly polarized light with a predetermined frequency; the modulation polarized wave is impinged upon and passed through a first quarter-wave plate and a second quarter-wave plate, the modulation polarized wave is impinged upon an analyzer and the analyzer converts the modulation polarized wave into a linear modulation polarized wave that oscillates in another direction, the linear modulation polarized wave is impinged upon a photodetector and the photodetector generates an electric signal corresponding to the physical property of the linear modulation polarized wave;

then, a test sample is disposed between the first quarter-wave plate and the second quarter-wave plate, the modulated polarized wave is passed there through, and the electric signal generated at the photodetector when the test sample is not disposed between the first quarter-wave plate and the second quarter-wave plate is compared with the transmission electric signal when the test sample is disposed between the first quarter-wave plate and the second quarter-wave plate and the stress of the test sample is determined;

wherein the electric signal is input to a DC-voltage indicator to indicate the detected value;

the polarizer is rotated and positioned such that the transmission principal axis thereof is positioned orthogonally to the oscillation direction of the laser light whereby the minimum value detected becomes M, and then the polarizer is rotated +45 degrees such that the detected value becomes a predetermined increased value M0 (M0>M);

the analyzer is rotated such that the principal axis thereof is positioned orthogonally to the principal axis of the polarizer whereby the linear modulation polarized wave arriving at the photodetector decreases and the minimum value detected becomes Mm1;

then, the polarizer is rotated such that the principal axis S thereof is positioned orthogonally to the principal axis of the analyzer whereby the minimum value detected further decreases to Mm2;

these operations are repeated whereby the angular position of the polarizer and the analyzer is set such that the detected value gradually decreases to Mmn (Mm1>Mm2>...>Mmn);

the photoelastic modulator is rotated such that the principal axis W thereof matches the principal axis S of the polarizer whereby the angular position is set such

that the minimum value detected becomes Mx;

the first quarter-wave plate is rotated such that the principal axis H thereof matches the principal axis S of the polarizer whereby the angular position is set such that the minimum value detected decreases to Mxm;

the first quarter-wave plate is rotated +45 degrees whereby the angular position is set such that the detected value becomes a predetermined increased value Mx1 (Mx1>Mxm) and the first quarter-wave plate has a property to convert the modulation polarized light from the photoelastic modulator to swirling linearly-polarized light;

in order that swirling of the linearly polarized light imparted by the first quarter-wave plate is countered when the second quarter-wave plate receives the linearly polarized light, the second quarter-wave plate is rotated whereby the angular position is set such that the principal axis thereof is positioned orthogonally to the principal axis direction of the first quarter-wave plate and the minimum value detected decreases to Mx1m (Mx1>Mx1m);

the polarizer is further rotated +45 degrees such that the principal axis thereof and the principal axis of the analyzer forms an angle, and the detected value is set as a reference electric signal of an increased value

x1m (x1m>Mx1m);

the reference electric signal generated at the photodetector is supplied to an amplifier, the amplifier amplifies the reference electric signal and supplies the amplified signal to a signal processor, and the signal processor generates a reference signal data;

then, a test sample is disposed between the first quarter-wave plate and the second quarter-wave plate, the modulated polarized wave is passed there through, at this time, the photodetector generates a transmission electric signal and supplies the transmission electric signal to the amplifier, the amplifier amplifies the transmission electric signal and supplies the amplified signal to the signal processor, and the signal processor generates transmission signal data, and the signal processor compares the reference signal data with the transmission signal data and determines stress of the test sample; and

a phase plate having a known phase difference is disposed as another test sample between the first quarter-wave plate and the second quarter-wave plate, transmission signal data is obtained at least twice while rotating the phase plate, the transmission signal data and the known phase difference thereof are input to the signal processor to determine the correlation there between, based on which a phase difference of a test

sample having an unknown phase difference is determined, and the phase difference thereof is converted to stress by the use of the photoelastic constant.